



Under the hood of DCART project

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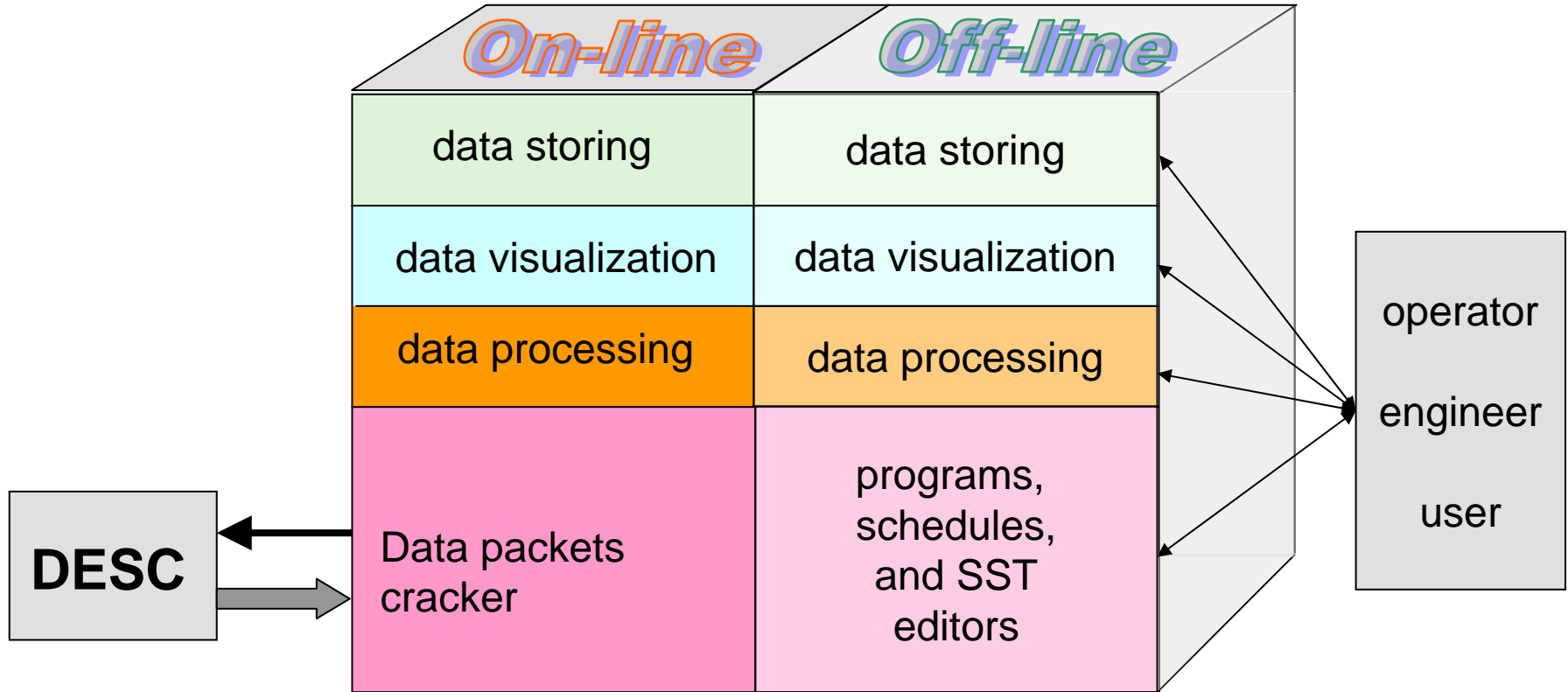
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30 APRIL TO 3 MAY 2007

New visible features of Digisonde

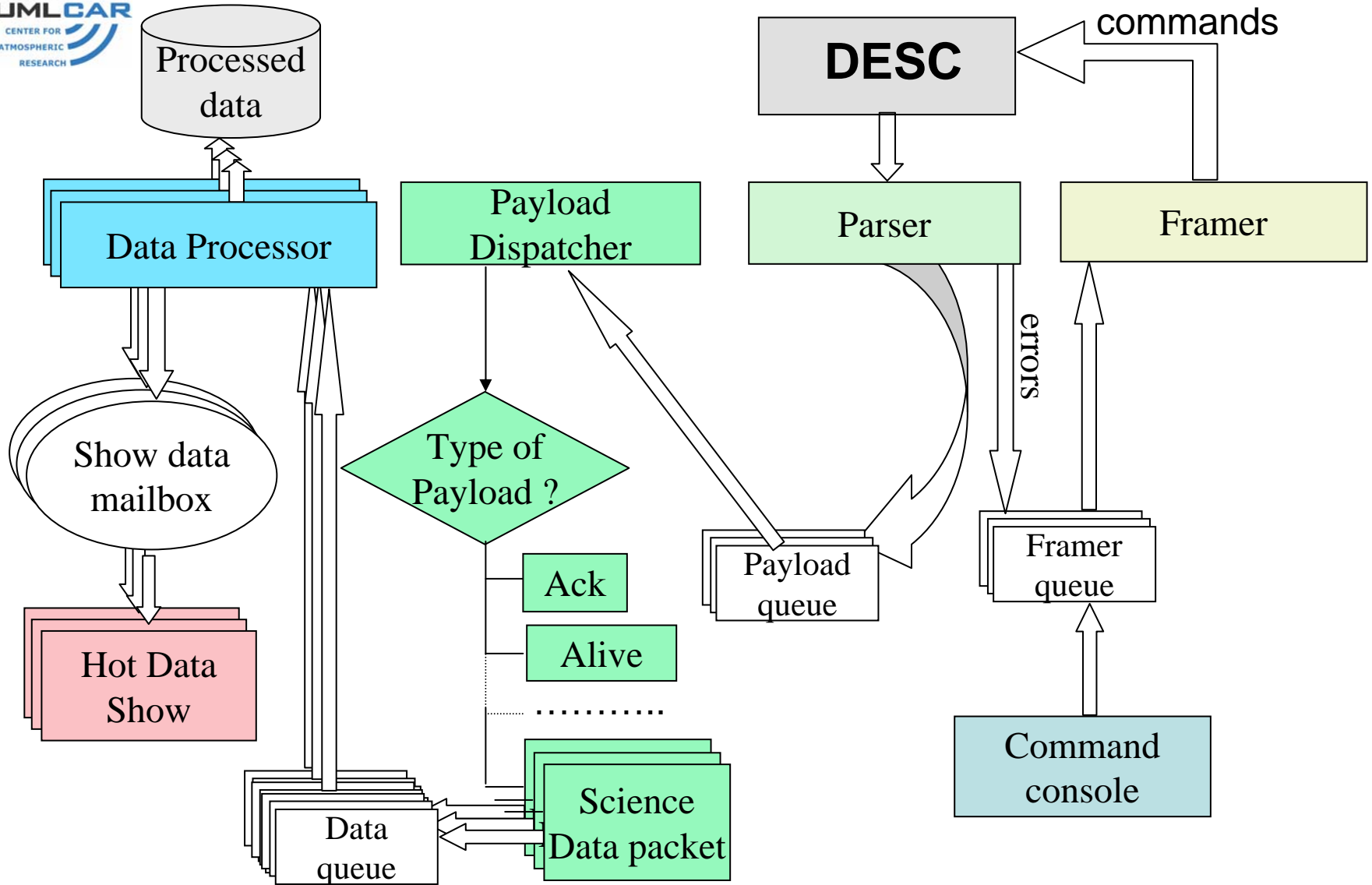
- **Resolution of scheduling to 5 millisecond**
- **Rule-based scheduling**
- **Raw data and off-line investigation of raw data**
- **Radio Frequency Interference Mitigation**
- **Listening mode**
- **Friendly and powerful interface**

Most of these visible features rely on software layer named DCART, implemented in Java 5 with its powerful object-oriented language, built-in threads, rich libraries (GUI, I/O, network and so on), and widely used event-driven architecture.

DCART general layout



On-line subsystem layout

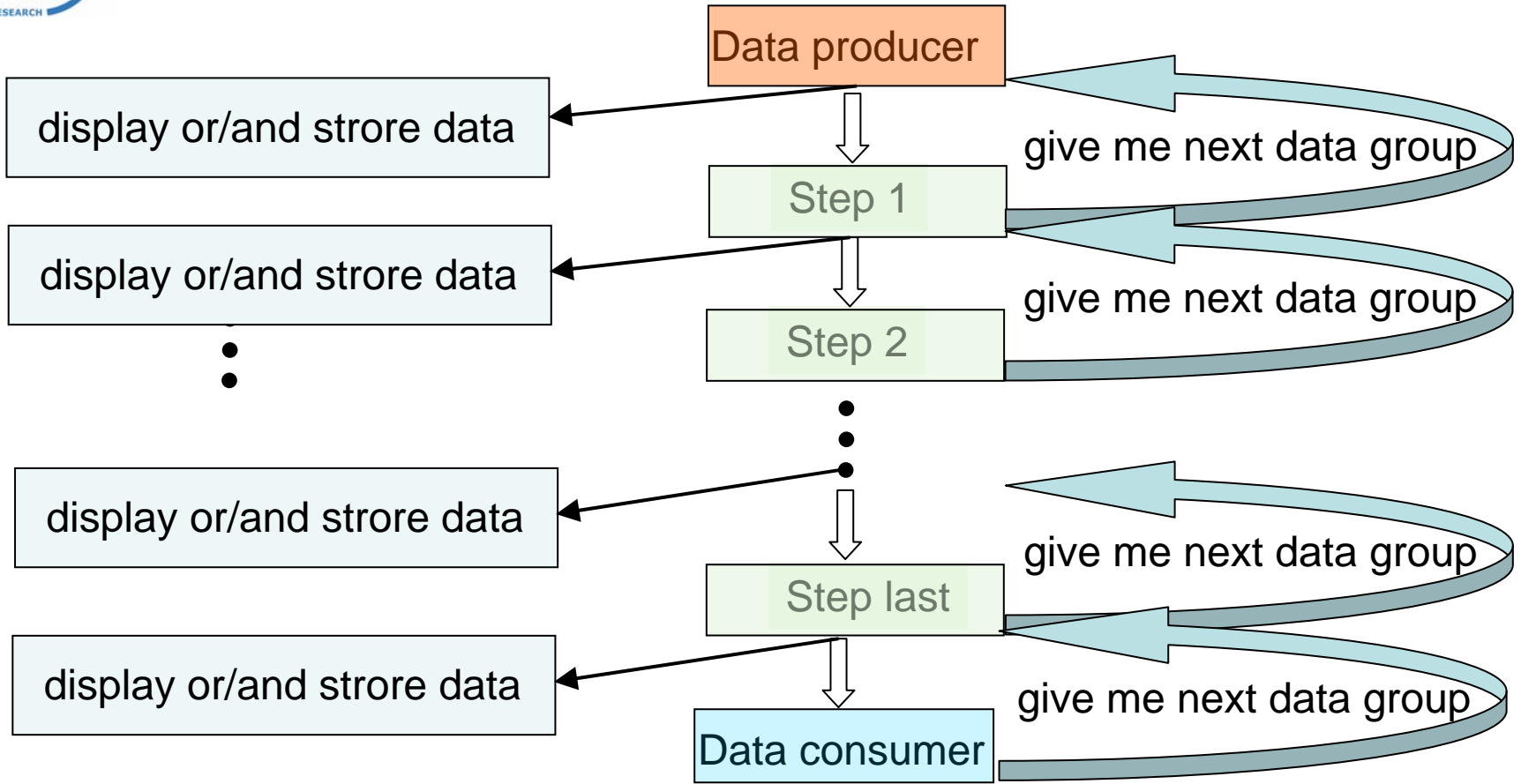


Data processing (DP) principles



- **Atomicity of processing and data:**
Data Processing consists of several DP steps
One step represents data processing algorithm
One algorithm takes one or several *Data Groups* and produces one or several *Data Groups*
- **Conveyor:**
Data Processing steps work in the same manner as conveyor where 'processing bricks' are Data Groups
- **Isolation:**
Data Processing steps are isolated from each other
- **Developer obligation:**
Coding of any Data Processing step has the mandatory conventions
These conventions are related with data processing
DP step developer can concentrate on algorithm itself
- **Off-line debugging and testing:**
having raw data developer can off-line debug and test data processing steps

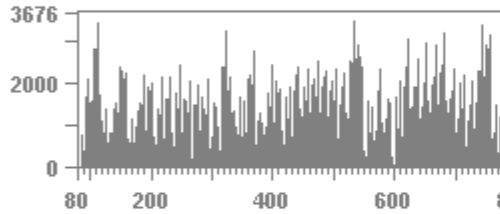
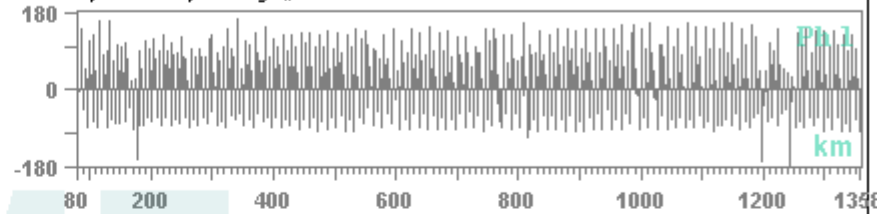
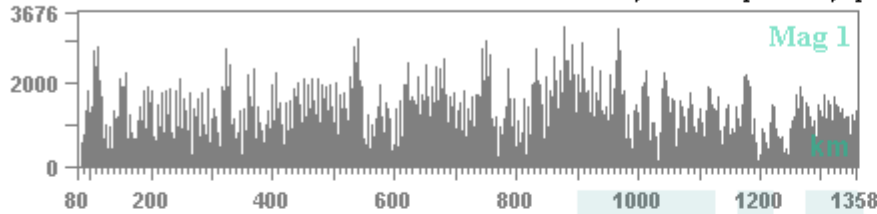
DP Conveyor



Data processing conveyor starts working from Data Consumer

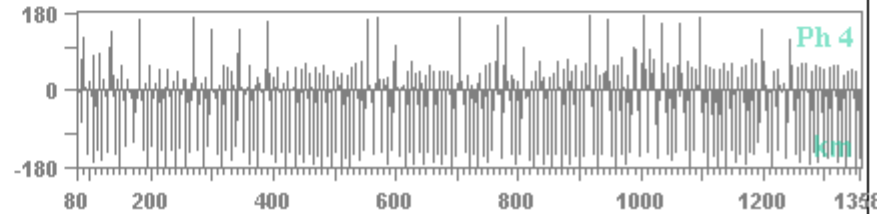
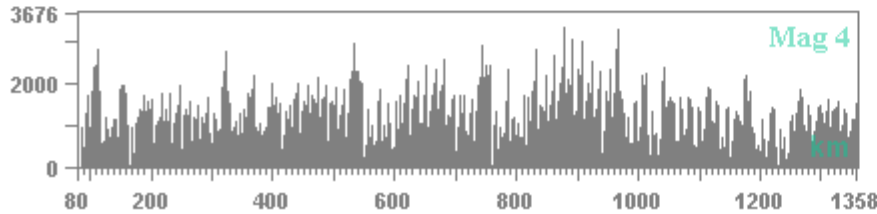
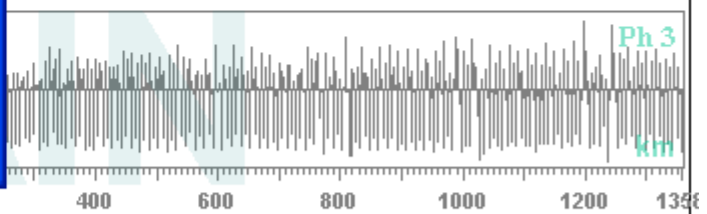
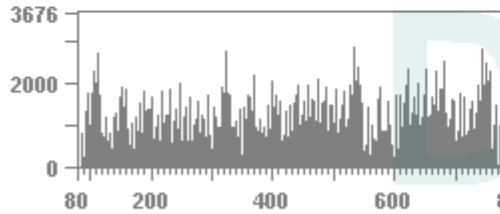
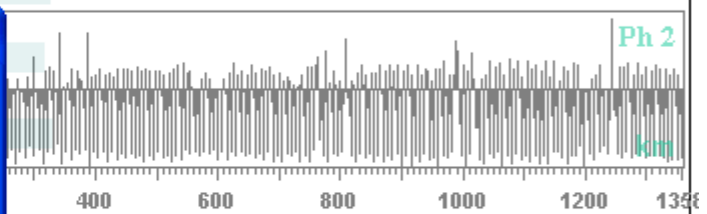
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 Millstone Hill 2007 Mar08 067 023035.920 714 100 -8 002

Look# 3592, Freq 1700 [kHz], Code 1, Polarization 0, Att 30dB, Sat 16383
 linear scale, max amp 3957, phase -147, ant 2, range# 355



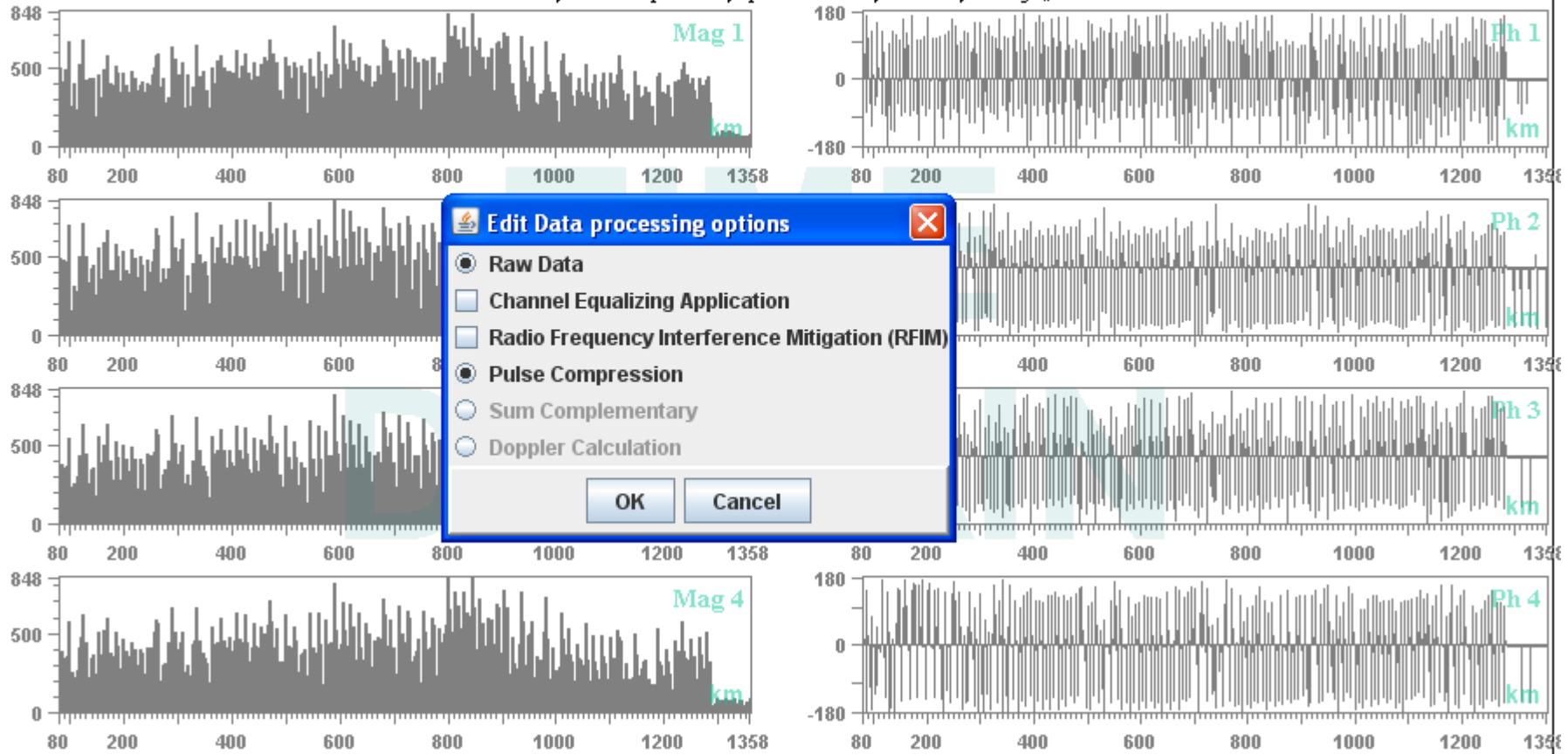
Edit Data processing options ✕

- Raw Data
- Channel Equalizing Application
- Radio Frequency Interference Mitigation (RFIM)
- Pulse Compression
- Sum Complementary
- Doppler Calculation



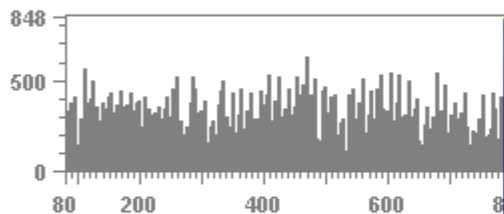
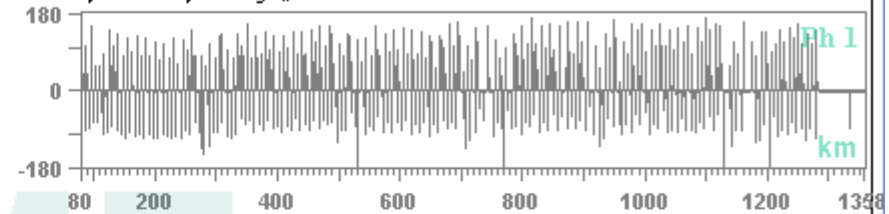
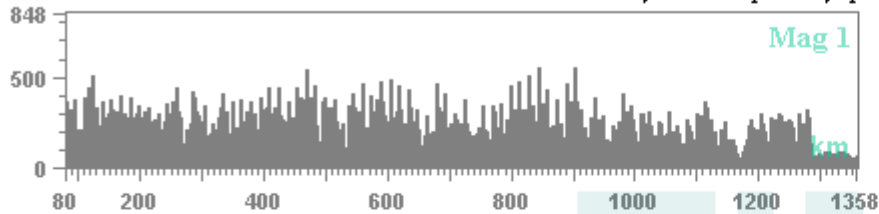
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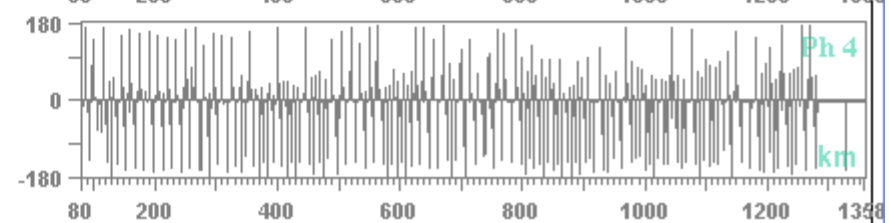
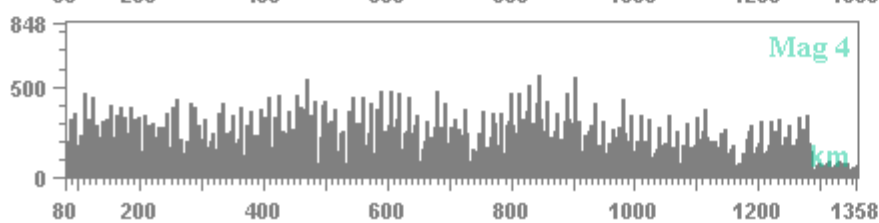
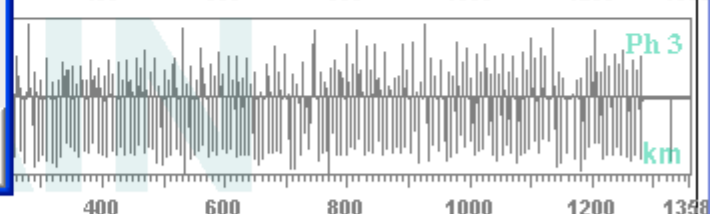
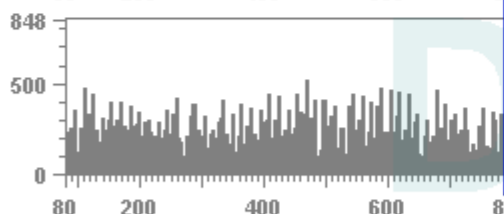
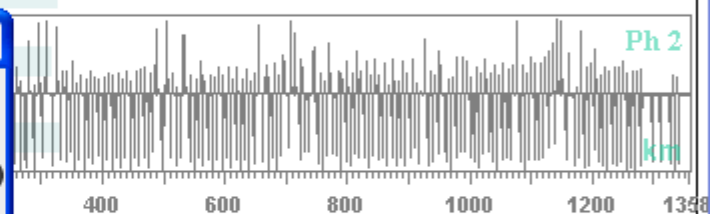
Look# 1796, Freq 1700 [kHz], Code 1, Polarization 0, Att 30dB, Sat 16383
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Edit Data processing options

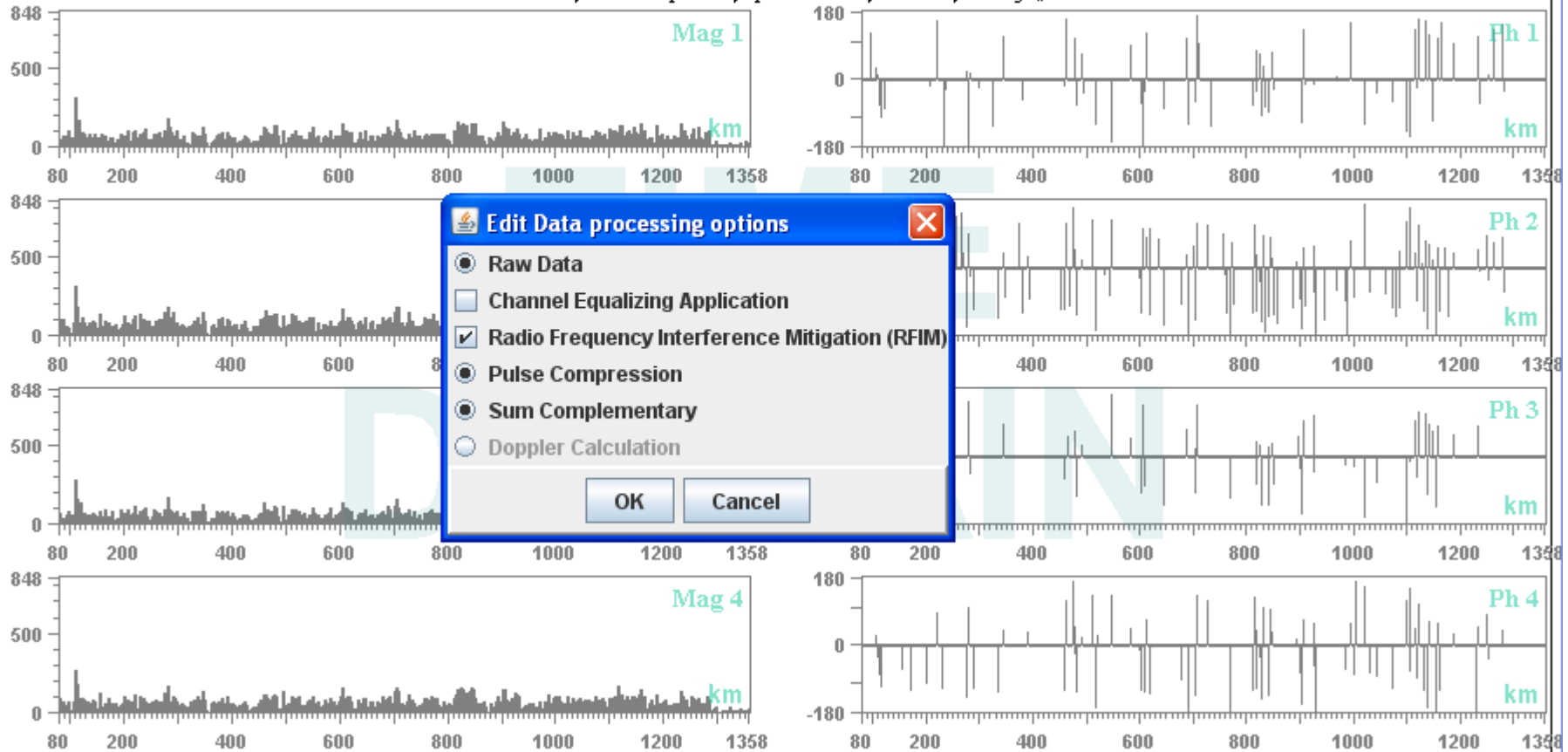
- Raw Data
- Channel Equalizing Application
- Radio Frequency Interference Mitigation (RFIM)
- Pulse Compression
- Sum Complementary
- Doppler Calculation

OK Cancel



STATION NAME YYYY DATE DDD HHMMSS.SSS AXN PPS IG PRN
 Millstone Hill 2007 Mar08 067 023035.920 714 100 -8 002

Look# 1796, Freq 1700 [kHz], Code 1, Polarization 0, Att 30dB, Sat 16383
 linear scale, max amp 319, phase -22, ant 2, range# 12



Data Processing step properties

- **Get method**
- ***Accumulating and Reduction Numbers***
 - *Accumulating number* says how many Data Groups DP step will accumulate before starting to process them
 - *Reduction number* says what times number of Data Groups will be reduced by applying this DP step
 - To get reduction number of DP you need just multiply reduction numbers of steps of this DP
 - Getting of accumulating number of DP is not so obvious
- **Modified in-place flag**

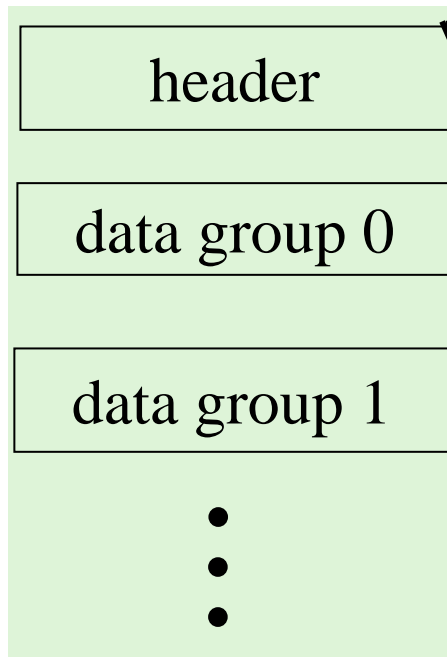
Generic data format

- **Reusable data structures**
- **Hierarchical structure**
- **Unified reader for all data types**
- **Version of data**

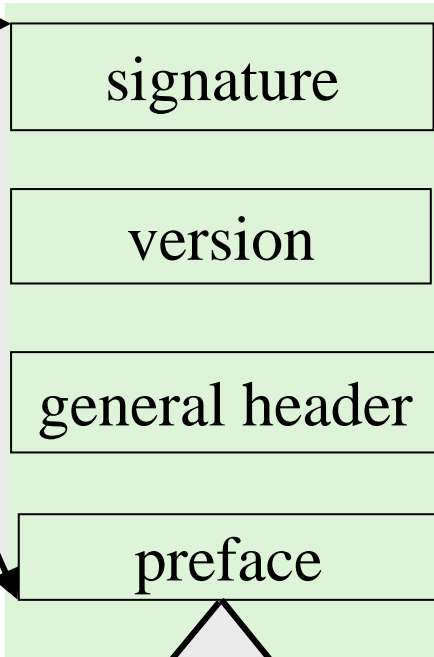
- **Program measurement** is the minimal data unit. Program measurement is uniquely identified by station and start time.
- Program measurement consists of Program header and number of Data Groups
- Data Groups:
 1. *Look*, corresponds to raw data acquired by DESC after one series of sampling (and it usually corresponds to one signal transmitting)
 2. *Doppler Frequency Group*, corresponds to data unit after *Doppler Calculation Processing Step*
 3. *Ionogram Frequency Group*, corresponds to data unit after *Ionogram Calculation Processing Step*

Generic Measurement Data Format

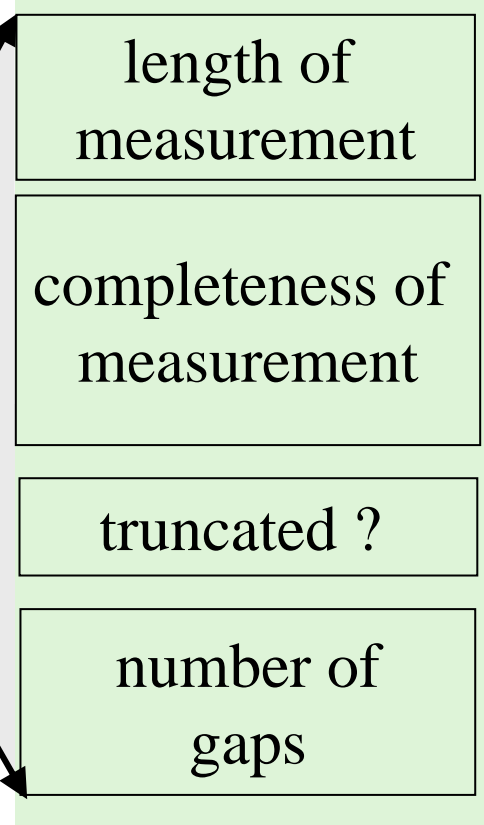
measurement



header

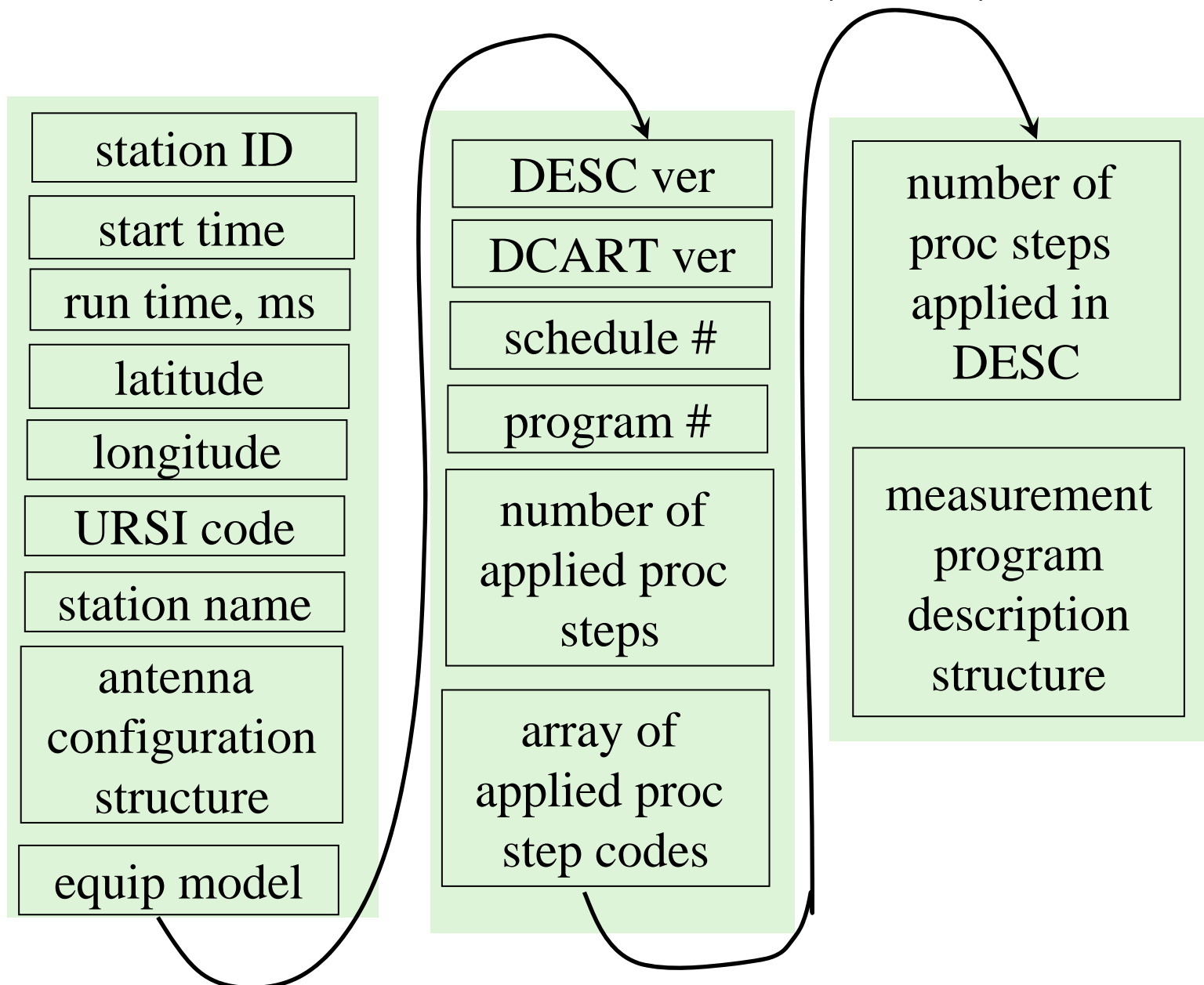


general header

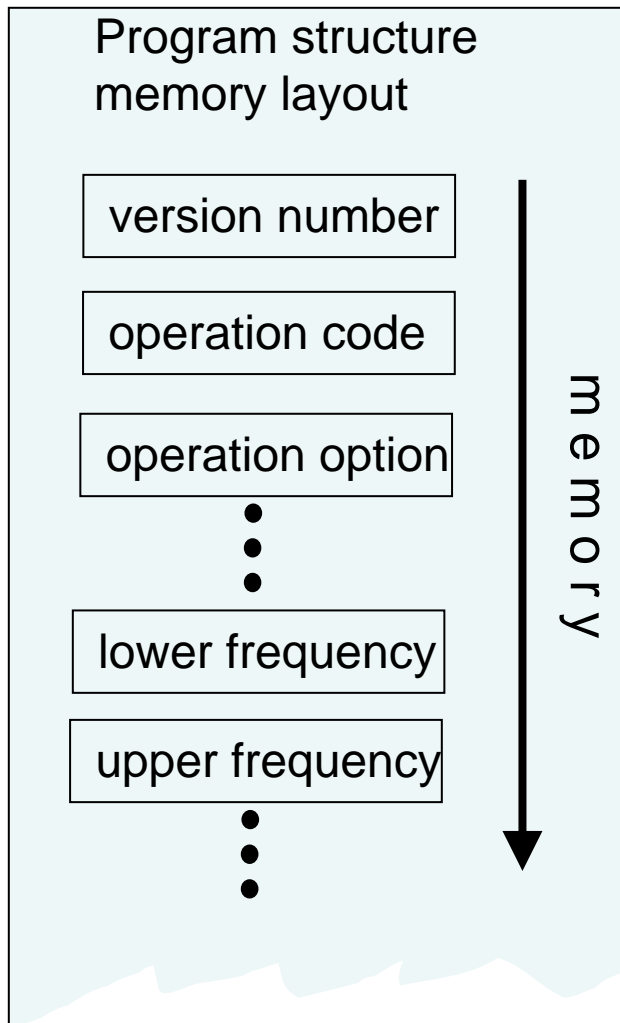


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Generic Measurement Data Format (Preface)



Versioning mechanism example



Large data structures, like Program data structure, contain its version inside of its content and this version number saved on disk (serialized) as the first element of this data structure.

It gives possibility to tune-up software reading engine on-the-fly when data is retrieving.

Returning to this example, it leaves developers the possibility to change Program structure in the future still having backward compatibility of reading engine.

Of course, maintenance of versioning mechanism for any structure requires quite a bit of developer attention, so only big and versatile structures might be in consideration for this feature.